

Human Cognitive Technology For Direct/Remote Control of Spacecraft Systems

Description and Objectives

Theme of Activity: Operation of Spacecraft Systems and Controls Using Human-In-The-Loop Cognitive Interfaces

Technical Description: The human brain generates electrical signals that can be mapped for specific commands that can be sent to spacecraft systems to carry out desired actions.

Physical Description: A neuro-signal acquisition interface(neuro-headset) combined with computer hardware can be used to sense calibrated electrical brain activity that processes electric signals from thought and converts them to onboard spacecraft systems and device commands.

Short List of Objectives

- Explore the functionality and capability of BCI headsets
- Integrate BCI headsets to selected test articles
- Operate test articles with BCI headsets
 - Using *EEG-cognitive control (original objective)
 - Using **EMG-facial expression control (expanded objective)

Technology Readiness/Implementation Approach: TRL: 3

Approach

- Acquire COTS technology and conduct tests to explore the ability to activate real and virtual devices through cognitive activity and interfaces
- Acquire software for concept development of custom cognitive control applications
- Partner with industry and academia to develop/test cognitive technology for spacecraft/robotic mission activities.
- Integrate emerging technology for operation of commercial spacecraft design and operation of robotic spacecraft missions

Collaborators/Roles

NASA Centers: JSC, ARC

JSC Organizations: EV, ER, SF

Industry: Emotiv, NeuroSky

Academia: TBD

Brain-Computer Interface (BCI) Headsets



Emotiv Epoc



OCZ NIA
(Neural Interface Actuator)



NeuroSky Mindset

Test Articles



Microsoft
Flight Simulator



LEGO Mindstorms



ISS Docking Simulator

Project Achievements

- EEG-Cognitive control of a LEGO Mindstorms robot (forward motion)
- EEG-Cognitive control of the ISS Docking Simulator (forward, reverse, left, right)
- EMG-Facial Expression control of the LEGO Mindstorms robot (forward, reverse, spin left, spin right)
- EMG-Facial Expression control of the Microsoft Flight Simulator (Climb, descend, left bank, right bank)
- EMG-Facial Expression control of the ISS Docking Simulator (forward, reverse, left, right)

*EEG = Electroencephalograph

**EMG=Electromyograph

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